

AD-A173 772

MICROCOMPUTER-CONTROLLED LANGMUIR-BLODGETT DIPPING
TROUGH(U) WISCONSIN UNIV-MADISON DEPT OF CHEMISTRY
H VAN RYSYK ET AL. 01 SEP 85 UMIS/DC/TR-86/1

1/1

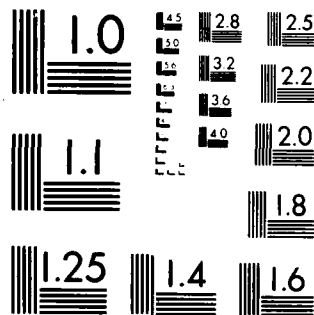
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

AD-A173 772

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>The lack of an inexpensive, commercial Langmuir-Blodgett film-deposition trough prompted us to build our own for the deposition of fatty-acid salts and tailor-made photochemically active agents upon a number of substrates. The films are characterized by their pressure-area isotherms, which are recorded by monitoring the film's surface pressure while compressing the surface area. Dipping requires slow immersion and removal of a substrate while continuously maintaining a preset surface pressure. Both of these tasks can be accomplished under microcomputer control.</p> <p>The software, run on an Apple II, is written in FORTH, allowing full, interactive control of dipping. The Apple controls a dc stepping motor, which compresses the film surface, while simultaneously monitoring a Cahn microbalance which reports surface pressure on a Wilhelmy plate. Pressure-area isotherms, standardized in molecular units of square angstroms, are displayed on the Apple screen and can also be stored or plotted. The deposition</p> <p>- see reverse side -</p>					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Distribution Unlimited		
22a. NAME OF RESPONSIBLE INDIVIDUAL Arthur B. Ellis			22b. TELEPHONE (Include Area Code) (608) 262-0421		22c. OFFICE SYMBOL

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Abstract continued

() substrate is mounted on a dipping arm driven by an ac motor. When dipping a sample, the Apple maintains the optimal surface pressure (as read from the isotherm), 0-100(± 0.1) dyne cm^{-1} , throughout the deposition process, allowing multilayer structures to be built automatically. The dipping rate is variable, allowing for slow deposition of initial layers and proceeding to faster deposition for subsequent layers. Finally, the Apple monitors the change in film area during dipping, to ensure full film uptake.

OFFICE OF NAVAL RESEARCH

Contract N00014-85-K-0631

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Technical Report No. UWIS/DC/TR-86/1

Microcomputer-Controlled Langmuir-Blodgett Dipping Trough

by

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Prepared for Publication in
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The trough used for the remaining film studies was milled from a solid piece of teflon, approximately 2 x 12 x 12 inches. The final dimensions of the trough are given in Figure 4.13, as is a schematic of the trough design. The trough was encased in aluminum to prevent distortion of the teflon. Sweeping arms and a compression arm were cut from excess teflon, and encased in aluminum metal to prevent warping. Figure 4.14 shows an expanded view of the final trough setup, including structure dimensions. The compression arm was connected to a stepping motor (Hurst Model #AS-30) to allow forward and reverse motion. A schematic of the dipping

Figure 4.13. Schematic of Langmuir trough. Inner trough dimensions are 7" x 10 1/2" x 1/2 ". Dipping well is 3/4" from one end and 2 1/4" from either side; its dimensions are 2 1/2" x 1" and it extends 1/2" below the trough floor. The entire trough is encased in 1/4" thick aluminum plate metal.

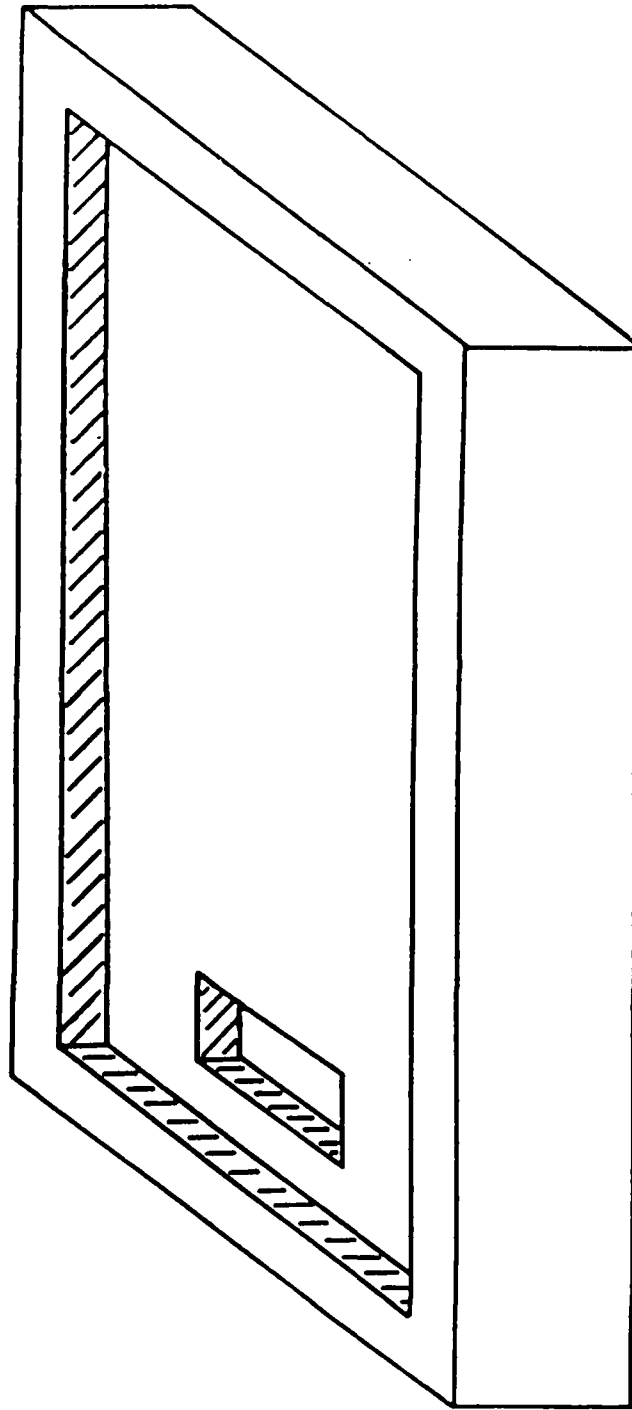
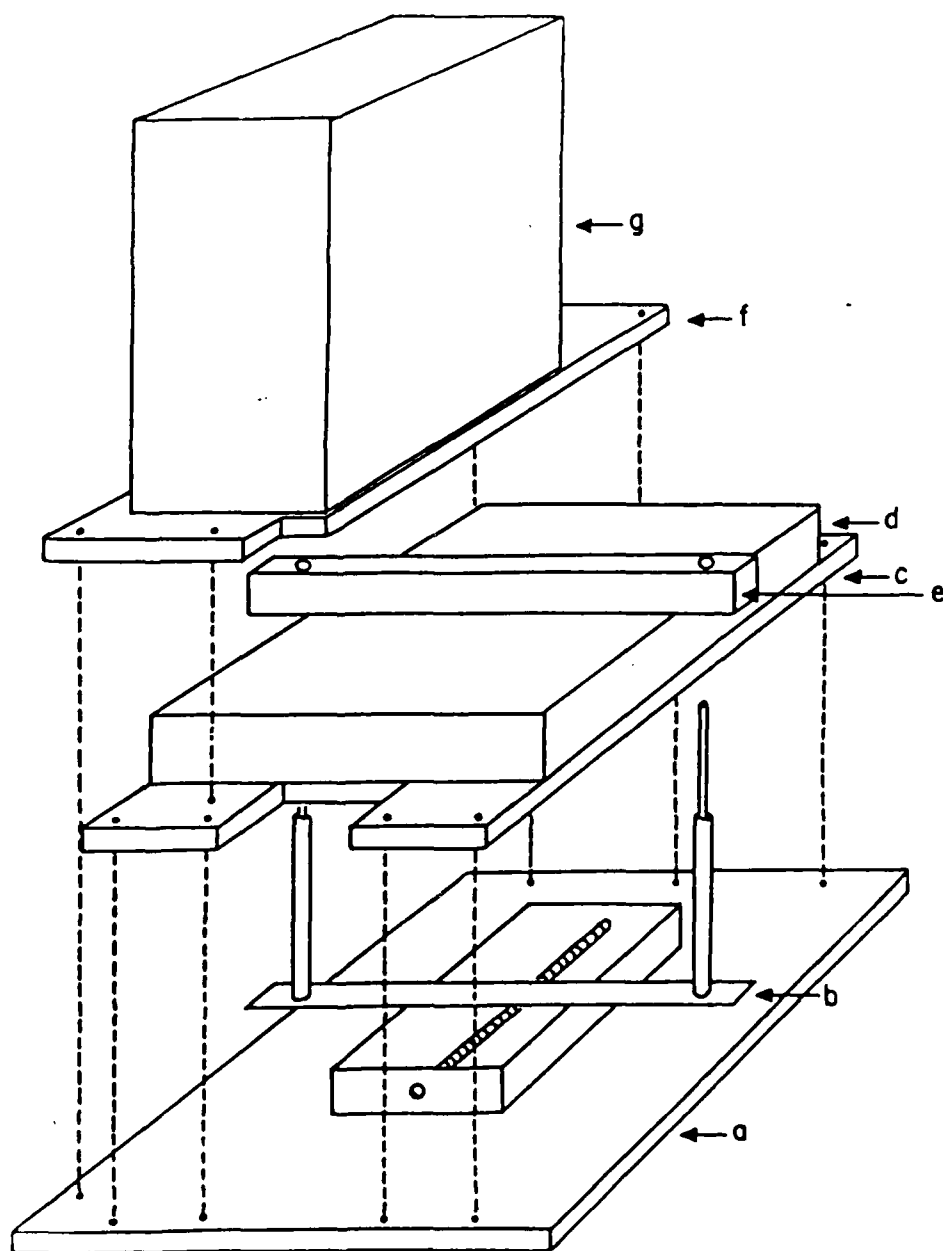


Figure 4.14. Schematic of trough setup. Floors are made of 1/2" thick aluminum plate metal. The bottom floor has dimensions of 12" x 16"; other floors are shown to scale, relative to the bottom floor, in the drawing. Support posts, shown as dashed lines in the drawing, are constructed from 3/4" diameter aluminum rods. The second floor is 3 1/2" above the bottom floor; the third floor is 15 1/2" above the bottom floor. Components of the setup, labelled in the diagram, are: (a) Bottom (motor) floor; (b) Motor block, consisting of stepping motor (not shown) and guiding mechanism for compression arm. The turn screw has 20 turns/inch; (c) Second (trough) floor; (d) Aluminum encased trough; (e) Compression arm which mates to posts on guiding mechanism; (f) Third (balance) floor; (g) Cahn Model 27 automatic electrobalance with external control unit (not shown). A hole is drilled in the third floor metal to allow suspension of the Wilhelmy plate below the balance. The entire setup is encased in a plexiglass case to prevent air drafts and contamination from dust.

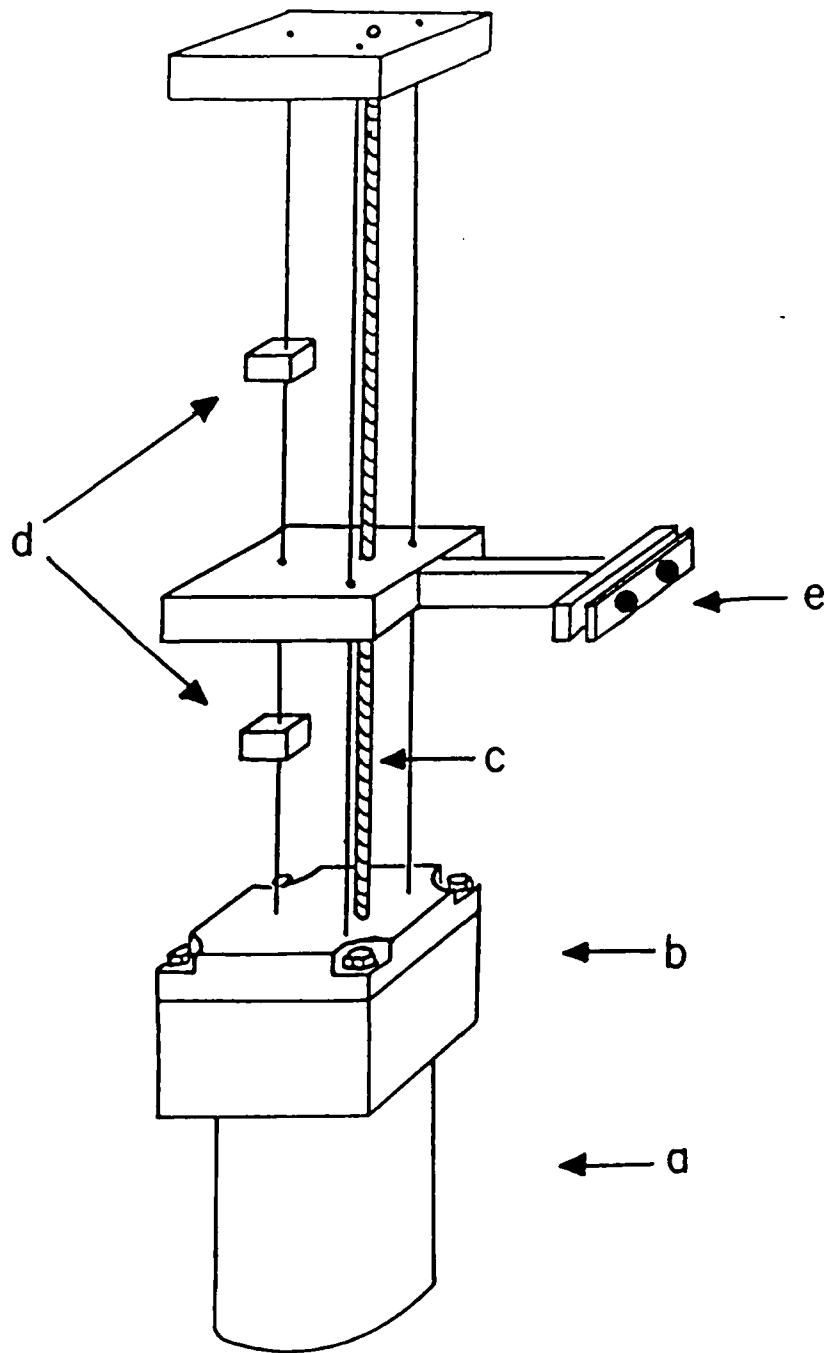


arm is shown in Figure 4.15. This arm was connected to a continuous, reversible motor (Japanese Servo Co., Model # RH2T6P4 connected to a Japanese Servo Co. gearbox Model #6H60) to allow immersion and removal of substrates from the water surface.

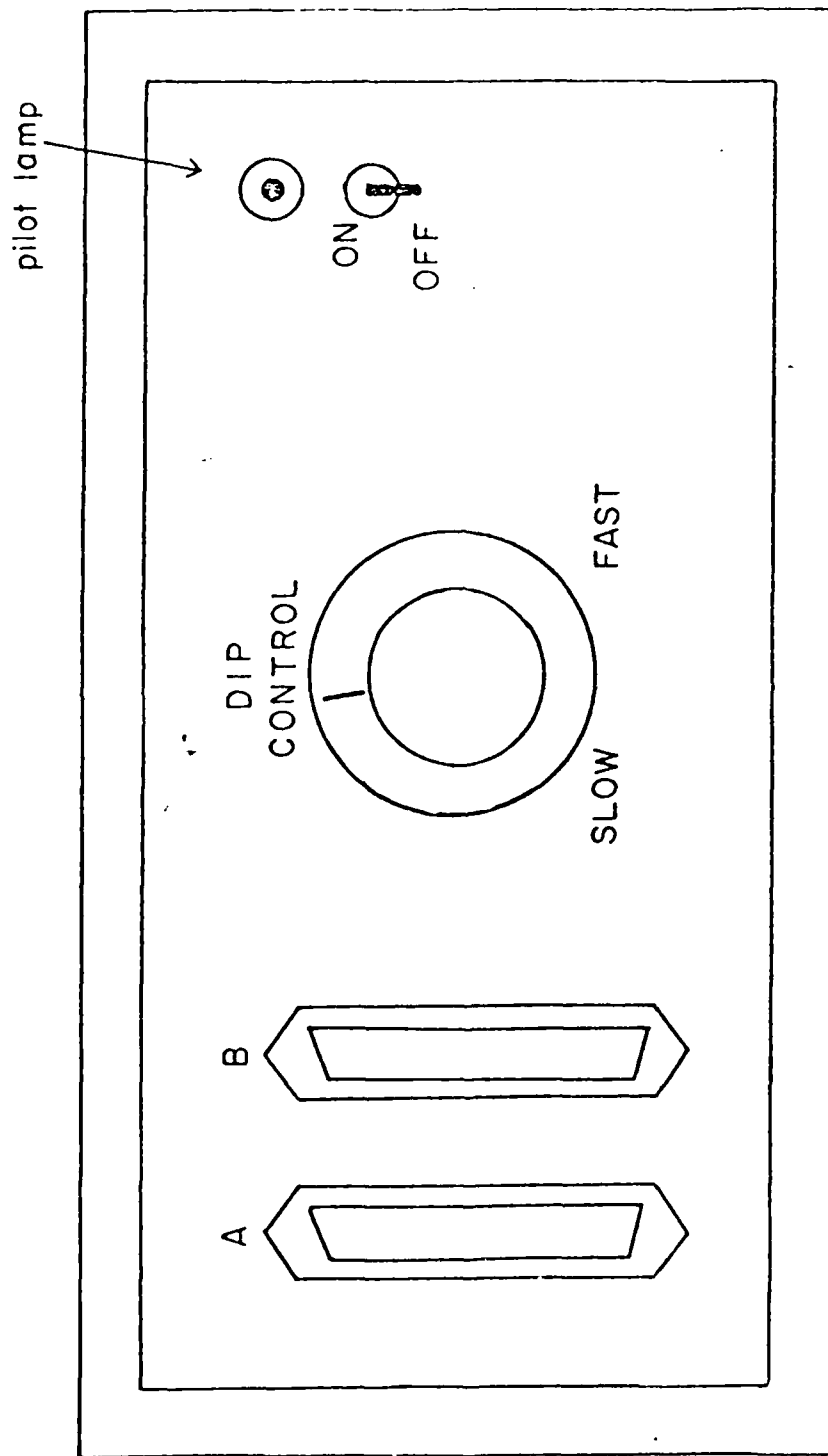
Surface pressures were measured using a platinum Wilhelmy plate (obtained from Cahn Instruments); plate dimensions are 2 cm x 1 cm x ~0.005 cm. The Wilhelmy plate was flamed clean before each use and was suspended from a Cahn Model 27 automatic electrobalance, which maintained the plate at a constant immersion depth throughout the experiments. The electrobalance and both motors were interfaced to an Apple IIe computer. In this manner, computer control was available for every step in the deposition process and for obtaining π -A curves. The computer program for running the trough was written in Forth, and is reproduced in Appendix I. Appendix 2 shows a schematic of the interface between the motors, the electrobalance, and the computer.

Figure 4.15. Schematic of dipping arm. The entire unit stands 14" tall. Square plates, shown in the drawing, are constructed from $1/2$ " thick aluminum plate metal and are $2\ 3/8$ " along each side. Posts, shown as lines in the drawing, are constructed from $1/4$ " diameter aluminum rods. Components of the dipping arm, labelled in the drawing, are:

- (a) Continuous, reversible motor;
- (b) Gearbox;
- (c) Turn screw (20 turns/inch);
- (d) Limit switches, attached to aluminum blocks mounted on aluminum rod. The limit switches can be positioned through use of set screws in the aluminum block;
- (e) Microscope slide holder.

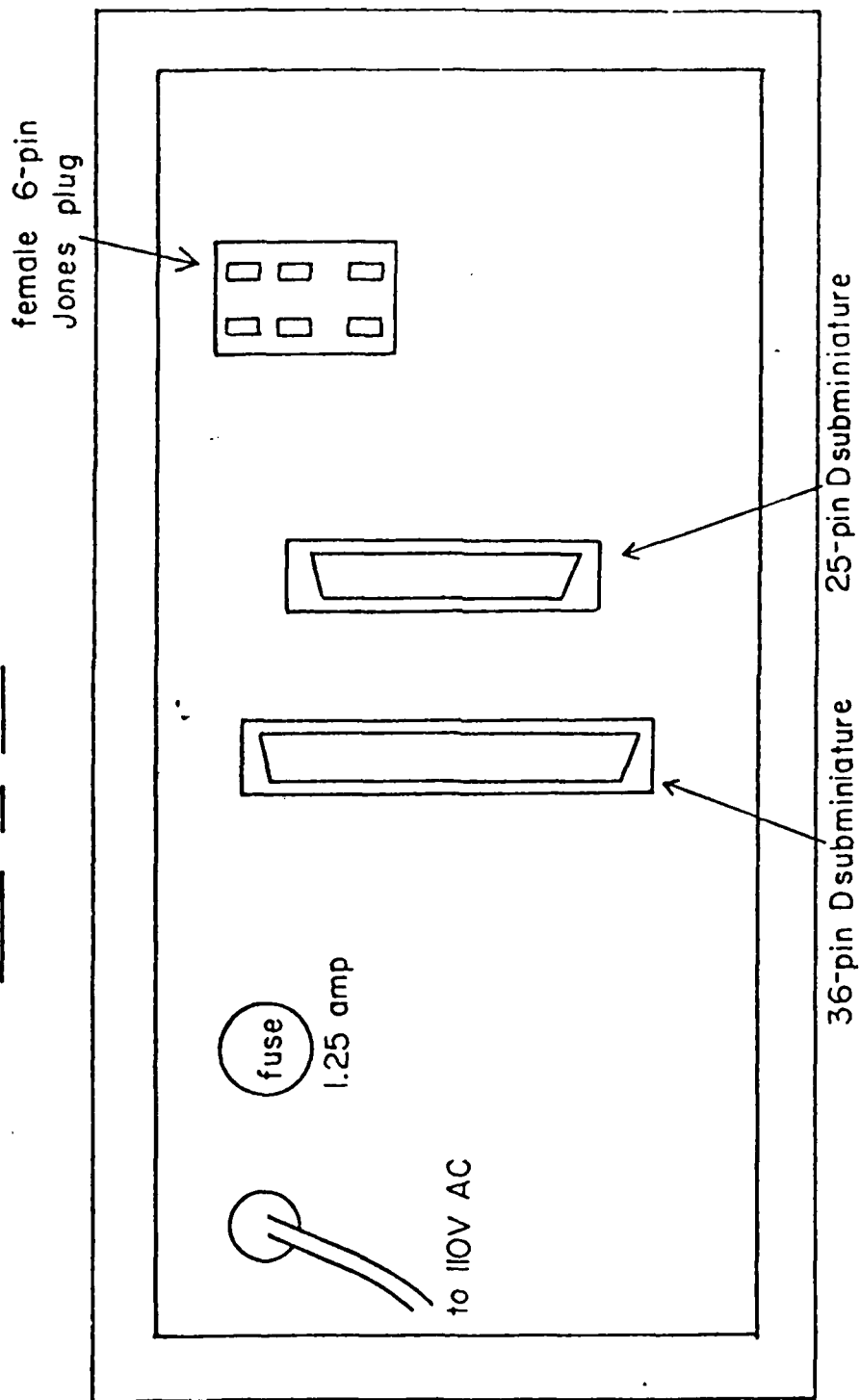


FRONT OF BOX



A & B = 36-pin Centronics, female chassis mount
DIP CONTROL = 1k Ω variable resistor

BACK OF BOX



CONNECTION SCHEME *

J	B	37-D
J1	19	5 \
2	20	6 / 1 st digit
3	21	7 \
4	22	8 /
5	23	9 \
6	24	10 / 2 nd digit
7	25	11 \
8	26	12 /
9	8	
10	7	
11	6	28 GND
12	5	29 Decimal wiper
13	4	
14	3	
15	2	
16	1	
J2	27	13 \
2	28	14 / 3 rd digit
3	29	15 \
4	30	16 /
5	31	17 \
6	32	18 / 4 th digit
7	33	19 \
8	34	20 /
9	16	
10	15	
11	14	28 GND
12	13	
13	12	
14	11	
15	10	
16	9	

* J= John Bell Engineering, Inc., 32-line digital I/O interface card for Apple II computer

B= 36-pin Centronics connector, designated as B on the front of the box

37-D= 37-D subminiature pin

CONNECTION SCHEME (cont.) *

J	A	37-D or 16 DIP
J3	1	19
	2	20
	3	21
	4	22
	5	23
	6	24
	7	25
	8	26
	9	8
	10	7
	11	6
	12	5
	13	4
	14	3
	15	2
	16	1
J4	1	27
	2	28
	3	29
	4	30
	5	31
	6	32
	7	33
	8	34
	9	16
	10	15
	11	14
	12	13
	13	12
	14	11
	15	10
	16	9

37-D

16 DIP

GND

GND

*J= John Bell Engineering Inc., 32-line digital I/O
Interface card for Apple II computer

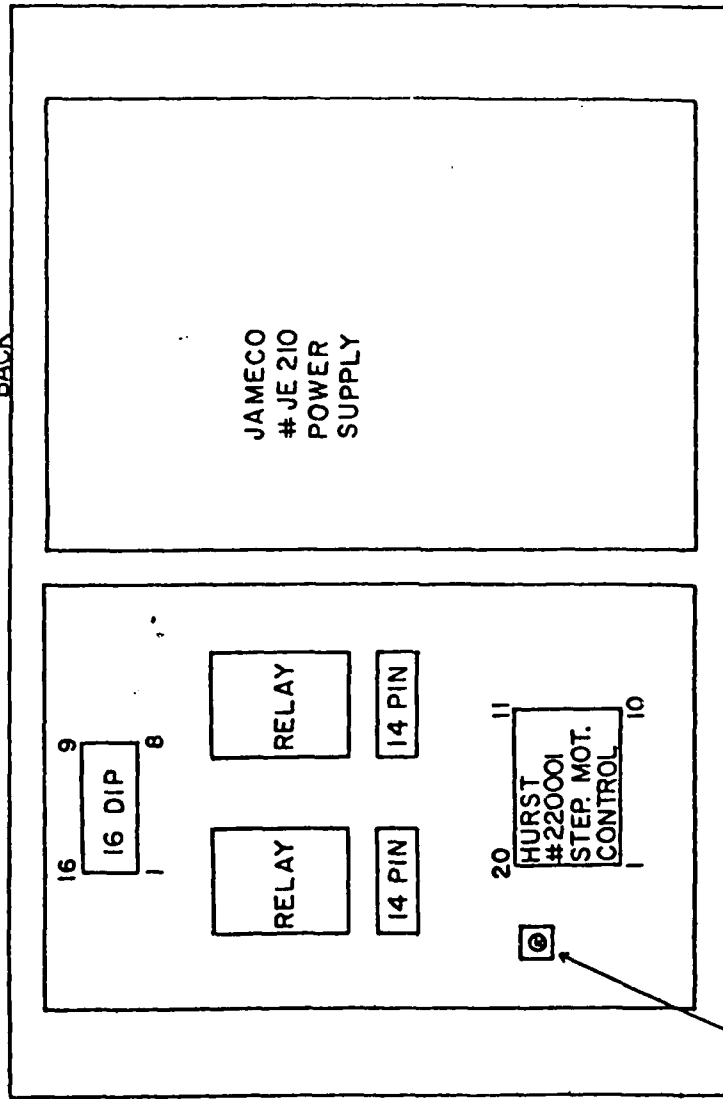
A= 36-pin Centronics connector, designated as A on
the front of the box

37-D = 37-D subminiature pin

16 DIP = 16 pin dual in-line package

INSIDE OF BOX

BACK



FRONT

- 14 PIN = 14 Pin wire wrap socket
- RELAY = Potter & Brumfield relay #2022
- 16 DIP = 16-pin dual inline package
- MSJ, variable resistor

SCR# 0

\ LANGMUIR-BLODGETT DIPPING ROUTINES
\ H. VAN RYSWYK, 31 MAY 85
\ Revised 2 APR 86

\ c/o Prof. A.B. Ellis
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\ This program coded in
\ Micromotion Masterforth V0.0
\ 12077 Wilshire Blvd, #506
\ Los Angeles, CA 90025
\ (213) 821-4340

SCR# 2

\ CONSTANTS, VARIABLES, STRINGS, BUFFERS, AND TABLES
50432 CONSTANT SWITCH 49152 CONSTANT KEYBOARD
49168 CONSTANT STROBE 40 CONSTANT BUFSIZE
454E0 FCONSTANT MFCNST 101.6E0 FCONSTANT AFNORM
FVARIABLE PCVRT FVARIABLE CPLATE
FVARIABLE TARGET FVARIABLE WTCLEAN
2VARIABLE NUM1 2VARIABLE NUM2
2VARIABLE PO 2VARIABLE POSIT
2VARIABLE INC VARIABLE FALLOFF
VARIABLE WAIT-TIME VARIABLE TREND
CREATE BUF BUFSIZE ALLOT CREATE BUF2 BUFSIZE ALLOT
CREATE EL 2 ALLOT 13 EL C! : ENDLINE EL 1 ;

\ TABLES

CREATE DIGITS (I/O PORT TABLE FOR JOHN BELL CARD)
50433 , 50560 , 50561 ,

SCR# 4

\ I/O

: HALT (HALTS T- AND DIP ARM)
255 SWITCH C! ;

: UP (MOVE DIP ARM UP)
HALT 252 SWITCH C! ;

: DOWN (MOVE DIP ARM DOWN)
HALT 253 SWITCH C! ;

: PULSE (JOGS T-ARM ONE PULSE)
SWITCH DUP C@ 8 XOR SWAP OVER OVER C! SWAP 8 XOR SWAP
3 0 DO LOOP (WAIT) C! ;

: FLOP SWITCH DUP C@ 4 XOR SWAP C! (FLIPS DIP DIR.) ;

SCR# 1

0 \ BRINGING THE SYSTEM UP...

1 \ BOOT DISK MUST ALREADY HAVE HIRES & FLOATING POINT ROUTINES
2 \ IN PLACE--YOU MAY FORGET ITWO & COSTBL TO SAVE MEMORY SPACE

3

4 FORTH-83

5 GRAPHICS ALSO

6 2 18 THRU

7

8

9

10

11

12

13

14

15

SCR# 3

0 \ I/O

1 : READSCALE (READS CAHN, --- FP)

2 DIGITS @ C@ 1 AND (READ MS-BIT)

3 3 1 DO

4 100 * 1 2* DIGITS + @ C@ DUP 240 AND 16 / 10 * SWAP

5 >R + R> 15 AND +

6 LOOP (INT CAHN READING ON STK)

7 S>D FLOAT DIGITS @ C@ 30 AND (FIND DECIMAL PLACE)

8 DUP 14 = IF DROP 10

9 ELSE DUP 22 = IF DROP 100

10 ELSE 26 = IF 1000

11 ELSE 10000

12 THEN THEN THEN S>D FLOAT F/ ;

13

14 : FINISHED (FLAG FOR DIP ARM LIMIT EXCEEDED, --- F)

15 SWITCH C@ 128 AND IF -1 ELSE 0 THEN ;

SCR# 5

0 \ CONVERSION

1 : VECTOR (FP MG --- DN PULSES) FABS PCVRT F@ F* FIX ;

2

3 : DMM (DN MM --- DN PULSES) FLOAT MFCNST F* INT ;

4

5 : DYNETOMG (CONVERTS PRESSURE IN DYNE/CM TO WEIGHT IN MG'S)

6 (FP --- FP) CPLATE F@ F/ FNEGATE WTCLEAN F@ F+ ;

7

8 : MGTODYNE (CONVERTS WEIGHT IN MG'S TO PRESSURE IN DYNES/CM)

9 (FP --- FP) FNEGATE WTCLEAN F@ F+ CPLATE F@ F+ ;

10

11 : READLN CR BUF BUFSIZE EXPECT BUF BUF2 SPAN @ CPACK ;

12

13 : GETFP (--- FP) READLN BUF2 DUP DUP C@ 1+ OVER C! DUP

14 C@ + 32 SWAP C! (ADD SPACE) FNUMBER FDUP DO= SWAP 0= AND

15 ABORT* USE SCIENTIFIC NOTATION * ;

SCR# 6

\ CONVERSION & I/O MACROS

: MM S>D DMH (INTEGER MM TO DN PULSES) ;

: AREA-OUT (DN PULSES --- FP MM^2)

FLOAT AFNORM F+ MFCNST F/ ;

: WAIT (TIMING LOOP) 8000 0 DO LOOP ;

: GETDN READLN BUF2 COUNT VAL DROP (-- DN) ;

: POSITION (SETS ARM POSITON VARIABLE)

CR ." ARM POSITION (IN INTEGER MM'S) * GETDN
DMH POSIT 2! CR ;

: SHOWSCALE (DISPLAY CURRENT CAHN READING)

READSCALE 4 9 F.R ;

SCR# 8

\ T-ARM & DIPPING ARM MACROS

\ T-ARM MOVEMENT (FP --- DN)

: EQUALIZE (EQ'S TO FP, LEAVES DN PULSES TRAVELED)

READSCALE F- FDUP DO= SWAP 0= AND IF FDROP 0 S>D

ELSE FDUP FO< IF VECTOR 2DUP COMPRESS DNEGATE

ELSE VECTOR 2DUP EXPAND THEN

THEN ;

: DIP

BEGIN TARGET FO EQUALIZE DABS 20. D< WAIT UNTIL 0 S>D

DOWN BEGIN FINISHED NOT UNTIL DOWN

BEGIN TARGET FO EQUALIZE D+ WAIT FINISHED UNTIL

HALT ." DELTA AREA = " AREA-OUT

3 6 F.R ." MM^2" ;

SCR# 10

: CLEANWATER (SETS CLEAN WATER WEIGHT VARIABLE)

CR ." WEIGHT FROM CLEAN SURFACE (IN MG'S SCI NOT)? "

GETFP WTCLEAN F! CR ;

: DEPOSIT

CR ." DESIRED SURFACE PRESSURE IN SCI. NOT. (DYNES/CM)? "

GETFP DYNETOMG TARGET F! CR

." NUMBER OF COMPLETE CYCLES (INTEGER)? " GETDN DROP

1+ HOME 1 DO I . ." DIP DOWN, " DIP WAIT UP WAIT

BEGIN FINISHED NOT UNTIL HALT CR ." UP, "

UNDIP WAIT DOWN WAIT BEGIN

FINISHED NOT UNTIL HALT CR

LOOP 3 0 DO 7 EMIT LOOP ." DONE!" CR ;

SCR# 7

0 \ T-ARM MOVEMENT (DN ---)

1 : EXPAND (MOVE T-ARM OUT DN PULSES)

2 2DUP POSIT 2@ D+ 2DUP NUM2 2@

3 D< IF POSIT 2!

4 ELSE 2DROP 2DROP

5 ." RANGE EXCEEDED. " ABORT THEN

6 BEGIN 2DUP DO= NOT WHILE FINISHED IF HALT THEN

7 PULSE 1 S>D D- REPEAT 2DROP ;

8

9 : COMPRESS (MOVE T-ARM IN DN PULSES)

10 FLOP (SELECT DIRECTION)

11 2DUP POSIT 2@ 2SWAP D- NUM1 2@ D- 0< SWAP DROP IF 2DROP

12 ." RANGE EXCEEDED." ABORT ELSE 2DUP POSIT 2@ 2SWAP D- POSIT 2

13 THEN BEGIN 2DUP DO= NOT WHILE FINISHED IF HALT FLOP THEN

14 PULSE 1 S>D D- REPEAT

15 FLOP 2DROP ;

SCR# 9

0

1 : UNZIP

2 BEGIN TARGET FO EQUALIZE DABS 20. D< WAIT UNTIL 0 S>D

3 UP BEGIN FINISHED NOT UNTIL UP

4 BEGIN TARGET FO

5 EQUALIZE D+ WAIT

6 FINISHED UNTIL

7 HALT ." DELTA AREA = " AREA-OUT

8 3 6 F.R ." MM^2" ;

9

10

11

12

13

14

15

SCR# 11

0 \ DATA TRANSFERAL PRIMITIVES

1 : ARRAY (# OF CELLS, CELL BYTES ---) (N --- ^ELEMENT)

2 CREATE DUP , * ALLOT

3 DOES> DUP @ ROT * + 2+ ; 150 6 ARRAY PRESSURE

4

5 \ GRAPHICS

6 : PLOT-INIT HGR 0 2000 10000 10000 VIEWPORT-SET

7 HOME 0 20 AT 0 0 14000 750 WINDOW-SET

8 0 750 MOVETO 0 0 LINETO 14000 0 LINETO

9 8 0 DO 1 100 * DUP 0 SWAP MOVETO

10 DUP 468 SWAP LINETO 50 + DUP 0 SWAP MOVETO

11 234 SWAP LINETO LOOP ;

12

13 : PLOT-IT (PLOTS P[N] VS. POSIT, N ---)

14 POSIT 2@ AREA-OUT FIX 6200. D- DROP

15 SWAP PRESSURE FO 1E1 F+ FIX DROP PLOT ;

```

SCR# 12
\ PRIMITIVES
: KEYCHECK KEYBOARD C@ 128 > DUP IF 0 STROBE C! THEN ( -- F ) ;

: (PA) 9 S>D BEGIN 1. D+ 2OVER COMPRESS
  WAIT-TIME @ 0 DO WAIT LOOP READSCALE MGTODYNE
  FDUP 7 PICK DUP >R PRESSURE F! R> PLOT-IT
  4 PICK 1- PRESSURE F@ F<
  IF FALLOFF DUP @ 1+ SWAP ! ELSE 0 FALLOFF ! THEN
  POSIT 2@ NUM1 2@ 2OVER 2OVER D< >R D= R> OR
  FALLOFF @ TREND @ = OR KEYCHECK OR UNTIL ;

: WRITEOUT ( FP --- )
  5 (E.R) PUTFILE ENDLINE PUTFILE ;

```

```

SCR# 14
\ RECORD PRESSURE-AREA CURVES
: PA ( --- N , WHERE N IS THE T-ARM INCREMENT )
  HOME ." P-A CURVES..." CR CR
  ." INCREMENT (INT MM'S)? " GETDN DMM 2DUP INC 2!
  PLOT-INIT POSIT 2@ P0 2!
  10 0 DO 2DUP COMPRESS WAIT-TIME @ 0 DO WAIT LOOP
    ( LET SCALE SETTLE ) READSCALE MGTODYNE
    I PRESSURE F! I PLOT-IT LOOP
    ." PRESS ANY KEY TO STOP." CR
    0 FALLOFF ! (PA) FLOAT 0 PRESSURE F! CR
  STORE? IF DNEGATE STOREDATA ELSE 2DROP THEN TX ;

```

```

SCR# 16
\ MACRO MOVES
: WHERE? ( REPORTS TENSION ARM POSITION )
  POSIT 2@ FLOAT MFCNST F/ 1 4 F.R ." MM." ;

: TOP ( MOVE DIP ARM TO TOP OF RANGE, THEN OFFSET )
  FINISHED NOT IF UP BEGIN FINISHED UNTIL HALT WAIT
  DOWN BEGIN FINISHED NOT UNTIL HALT THEN ;

: BOTTOM ( AS WITH TOP... )
  FINISHED NOT IF DOWN BEGIN FINISHED UNTIL HALT WAIT
  UP BEGIN FINISHED NOT UNTIL HALT THEN ;

```

```

SCR# 13
0 \ DATA STORAGE
1 : STORE? ( QUERY, --- F ) CR ." DO YOU WANT TO SAVE THIS RUN?"
2 READLN BUF2 1+ C@ DUP ASCII Y = >R ASCII y = R> OR ;
3
4 : STOREDATA ( DN --- , WHERE N IS THE T-ARM INCREMENT )
5 CR ." FILE NAME? " READLN 2 DR# BUF2 COUNT TEXT MAKE IS OUTPL
6 ." DATA TRANSFER IN PROGRESS..." CR
7 0 PRESSURE F@ 2E0 F* WRITEOUT
8 P0 2@ 0 PRESSURE F@ FIX DROP
9 1+ 1 DO
10 2DUP AREA-OUT WRITEOUT
11 2OVER D+
12 I PRESSURE F@ WRITEOUT
13 LOOP OUTPUT CLOSE 2DROP 2DROP ;
14
15

```

```

SCR# 15
0 \ PA'S, CONT.
1 : PA-REVERSE ( REVERSES PA CURVE, --- ) POSIT 2@ P0 2!
2 HOME 0 20 AT 6R ." P-A REVERSE..."
3 0 PRESSURE F@ FIX DROP 1+ 1 DO
4 INC 2@ EXPAND WAIT-TIME @ 0 DO WAIT LOOP
5 READSCALE MGTODYNE I PRESSURE F! I PLOT-IT
6 LOOP
7 STORE? IF INC 2@ STOREDATA THEN TX ;
8
9
10
11
12
13
14
15

```

```

SCR# 17
0 \ SYSTEM REPORTS
1 : STATUS HOME
2 ." TRANSVERSE ARM IS AT " WHERE? CR
3 ." WEIGHT FROM CLEAN SURFACE IS " WTCLEAN F@ F. ." MG." CR
4 ." TREND IS " TREND @ . ." POINTS." CR
5 ." WAIT-TIME IS " WAIT-TIME @ . ." SEC." CR
6 SWITCH C@ DUP 3 AND 0 = IF ." DIPPING ARM UP."
7 ELSE 2 AND 0 = IF ." DIPPING ARM DOWN."
8 ELSE ." DIPPING ARM AT REST." THEN THEN CR CR ;
9
10
11
12
13
14
15

```

\ INITIALIZATION

: STARTUP 80COL

127 SWITCH 2+ C! 255 SWITCH C!

30418. NUM1 2! 89438. NUM2 2! (ABSOLUTE PULSE #'S)

10E0 PCVRT F! 0.491E0 CPLATE F!

3 TREND ! 6 WAIT-TIME !

." TURN BOX ON..." CR CR

CLEANWATER

POSITION ;

Dictionary of Terms

Position enters the correct the position of the arm into the computer.

Where? tells where the computer thinks the compression arm is. (Position is read from leading teflon edge of the arm, towards the dipping well.)

Cleanwater inputs changes in the surface pressure of the clean, film free, water surface.

Up moves the dipping arm up (Must be stopped with the **Halt** command) Use carefully!

Down moves arm down (Must be stopped with the **Halt** command) Use carefully!

Halt stops the motion of the dipping arm in the up or down mode.

Top moves the dipping arm to top of the range and then offsets.

Bottom moves the dipping arm to the bottom of the range and then offsets.

Status lists the status of the system.

transverse arm	(in motion or at rest)
wieght from clean surface	###
trend is	#
wait-tim	#
dipping arm	(in motion up/down or at rest)

X MM Compress (or) Expand will move the compression arm the desired mm's.

PA will measure the Pi-A curve. It will ask for intervals- 1mm is best to get accurate results. Program stops after recording three consecutive points where the surface pressure decreased.

Pa-Reverse runs a backward Pi-A curve to examine the extent of collapse and hysteresis. Unfortunately, there is often transfer of film to the plate which prevents a real measurement of the surface pressure on the reverse.

Storedata stores the PA curve if the program should be unwilling to let you do so automatically.

Deposit will deposit films on the slide. It will ask for pressure of transfer and for the number of dipping cycles desired. It is best to have the surface pressure close to that desired for dipping to prevent the computer from overstepping the condensed phase. There are times when the deposit cycle believes it has made several dips when in reality it has only done one. This can be seen in the area changes listed for each dip. (An area change of 0 would indicate no dip was made.) Also, changes in the dipping arm contacts are possible to vary the time for the cycles. Greater separation of the contacts gives longer times to allow the film to dry, closer distances give shorter times so each dip accomplished faster.

Dip is a sub command of Deposit and brings the slide down while maintaining the constant surface pressure given in the deposit command.

Undip is a sub command of the deposit routine. It brings the slide up while maintaining the constant surface pressure given in the deposit command. This is particularly useful if the switch fails, as it often does on the slow first dip.

XEN MGTODYNE F. converts the scale measurement of mg to the surface pressure in dynes. The number must be in scientific notation 147=1.47E2=147E0 either of the last two are acceptable.

XEN DYNETOMG F. converts the surface pressure in dynes to a force in mg readable from the scale. Again, this must be in scientific notation.

Variables that are variable!

In order to see these, type "status" which will report with the present value for each of these (not Cplate):

Trend is the number of consecutive points which have decreasing surface pressures which the PA curve uses as the signal for collapse of the film. Not as important now that the PA can be stopped from the key-board after the first six points.

Wait-time is the time the computer waits between 1mm steps. This allows variation of the compression rate (approx. 3A2/molecule/minute).

Cplate is the inverse of the perimeter of the Wilhelmy plate, needed only with a new plate.

To Change a Variable: # VariableName ! (CR) integer
VariableName F! (CR) floating pt. number

END

12-86

DTIC